Oct. 10, 1950

R. E. PABST

2,525,560

LOW TEMPERATURE DEFROSTING SYSTEM

Filed Feb. 4, 1949

4 Sheets-Sheet 1

Fig. 1.

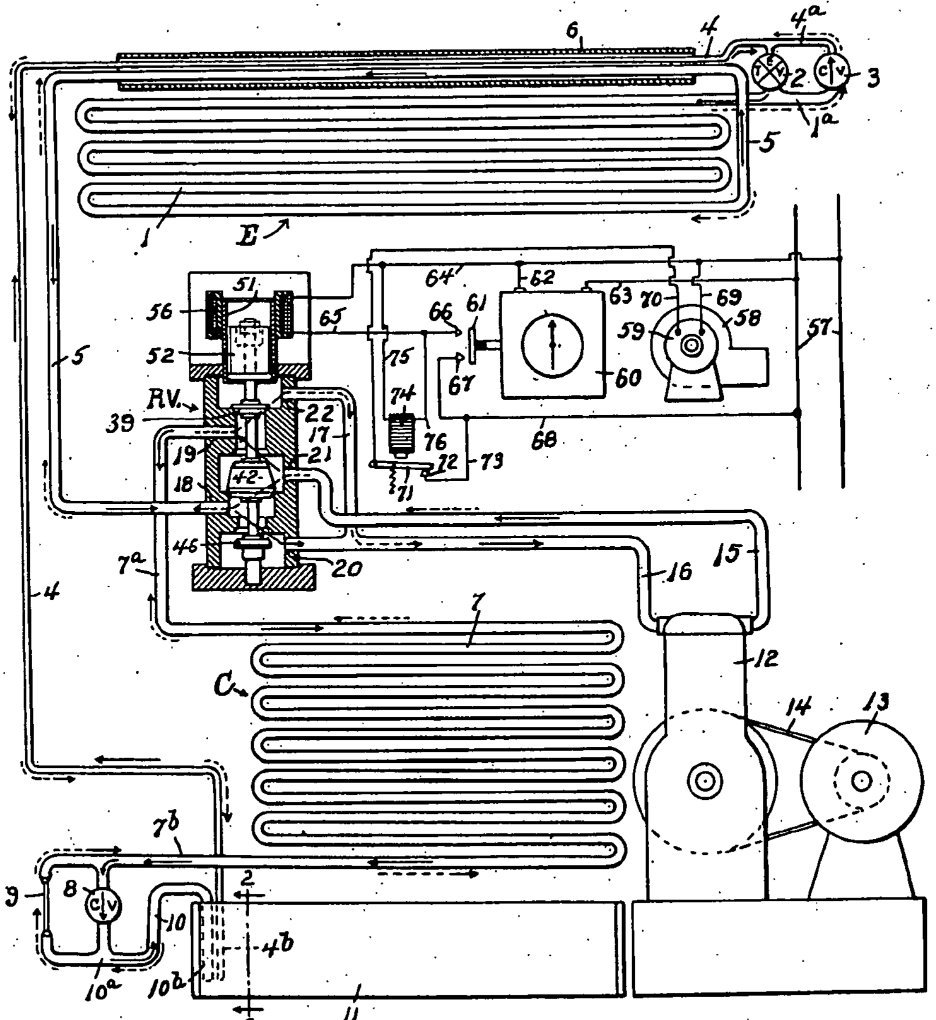

Fig. 2.

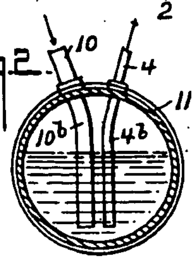

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Fig. 4.

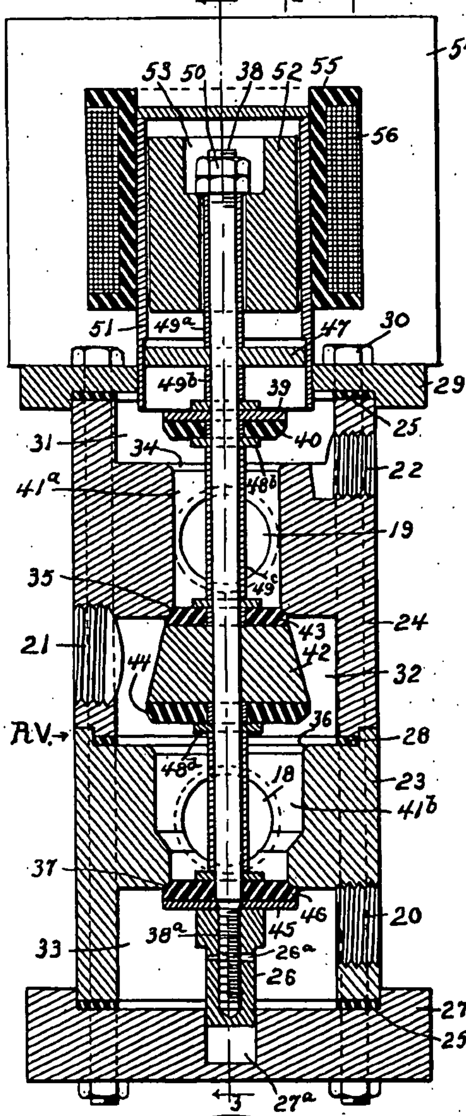


Fig. 3.

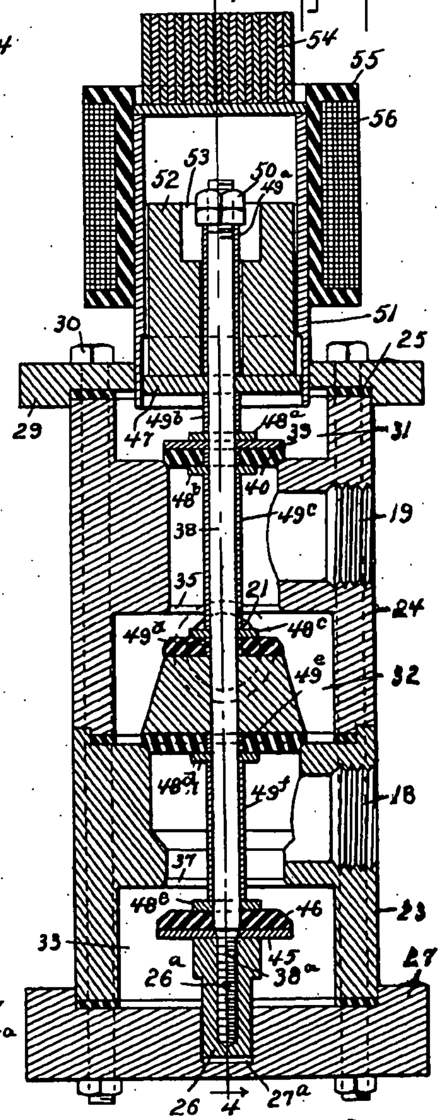
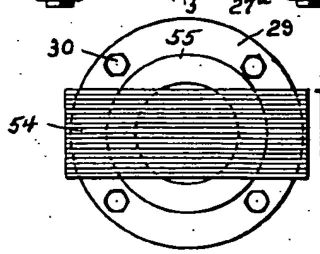


Fig. 5.



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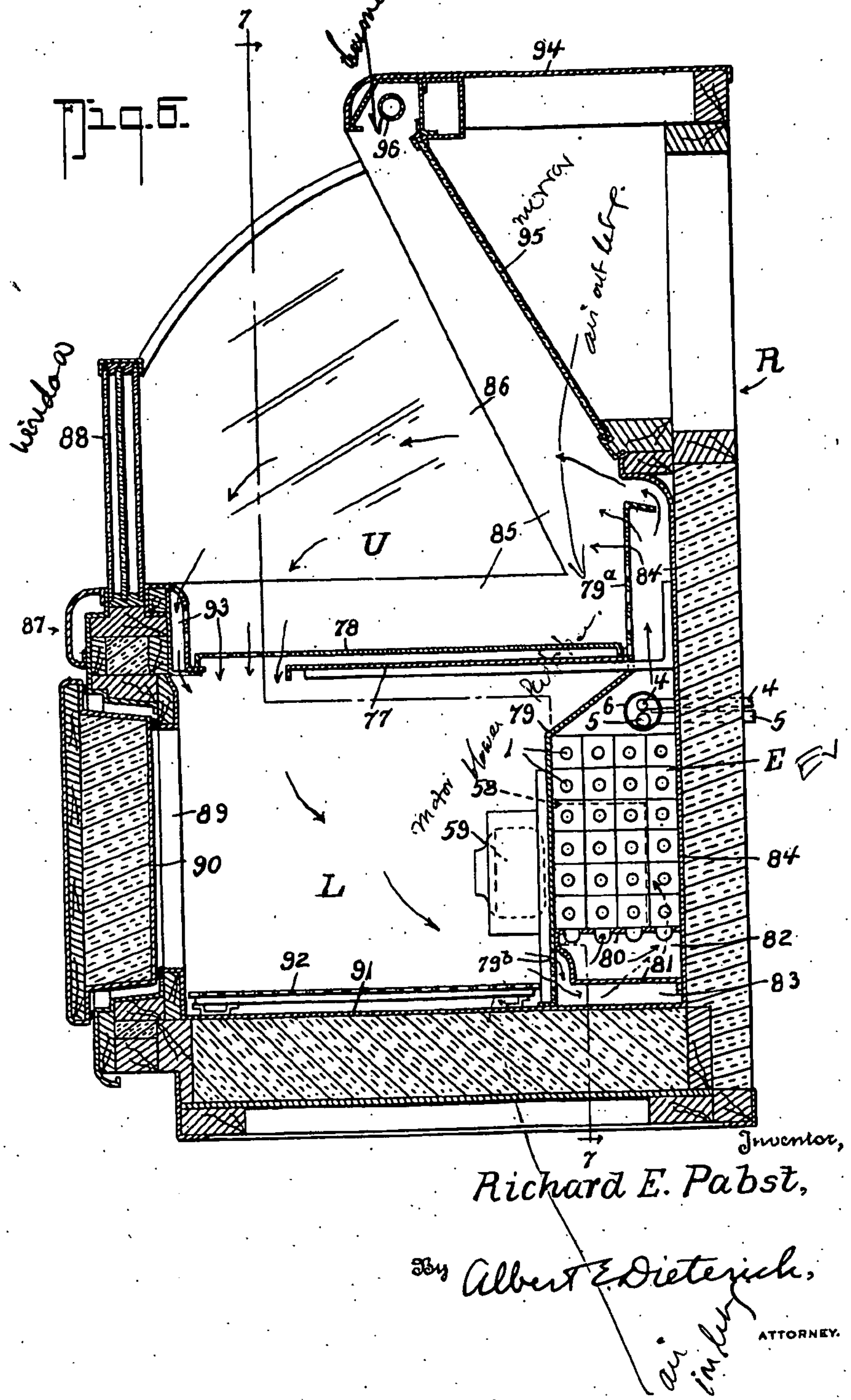

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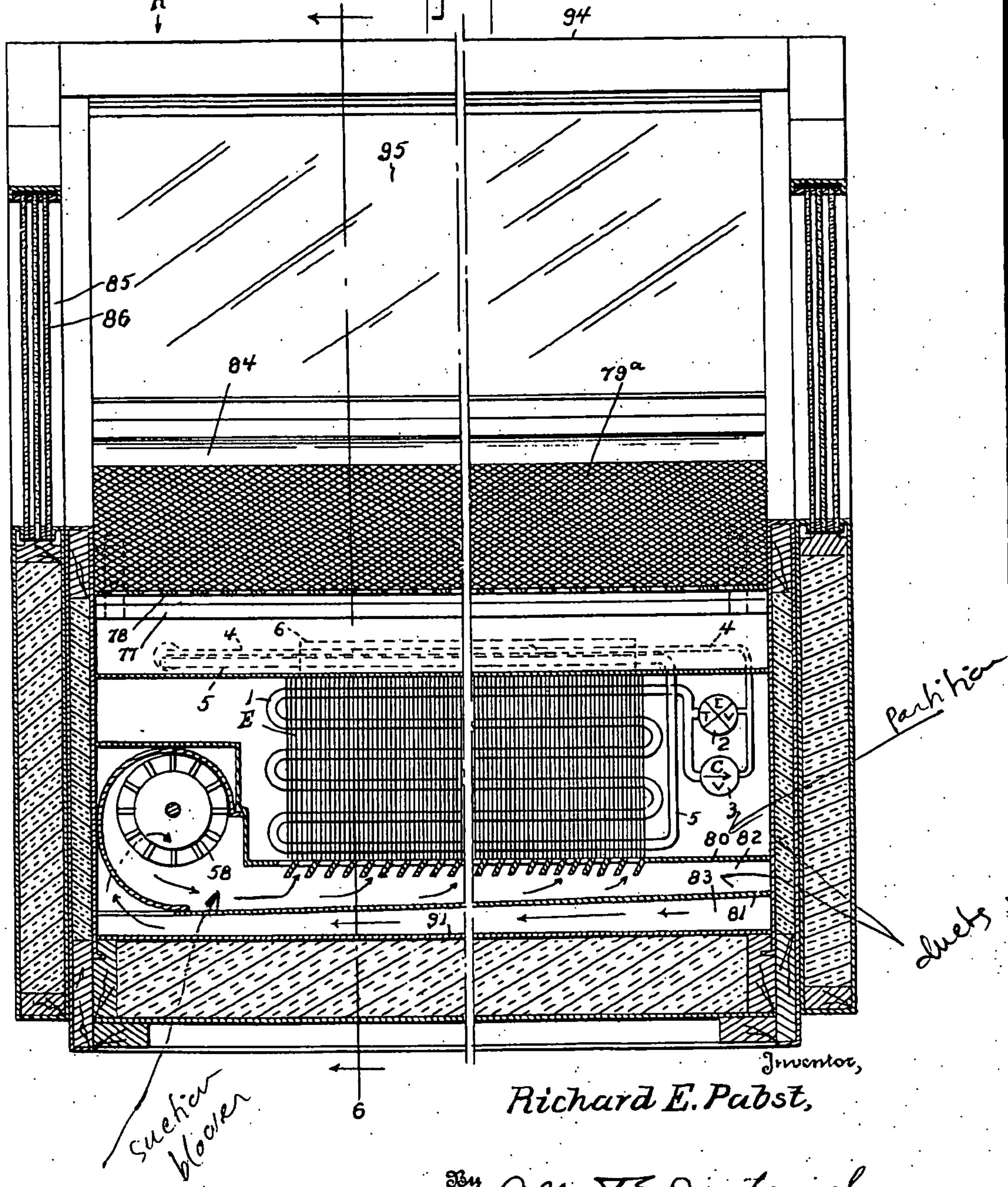
Fig. 7



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Patented Oct. 10, 1950 2,525,560

UNITED STATES PATENT OFFICE

2,525,560

LOW-TEMPERATURE DEFROSTING SYSTEM

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2 Claims. (Cl. 62—117.55)

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My invention has for its object to provide a refrigerator with a cooling and defrosting system and means for circulating the cold air in the refrigerator only during the cooling period, i. e., when the evaporator is being defrosted the air circulating blower is stopped.

Another object is to provide a time controlled electro-magnetically actuated reversing valve for reversing the connections between the compressor and the evaporator and condenser whereby at stated intervals and for predetermined time intervals the functions of the evaporator and condenser are reversed.

A further object is to provide an improved construction of reversing valve wherein the construction and operations of the parts are such that valve sticking is avoided and snap action is obtained.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will be first fully described in the following detailed description, and then be particularly pointed out in the appended claims, reference being had to the accompanying drawing, in which:

Fig. 1 is a schematic view of the cooling, defrosting and air moving system embodying my invention.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section of the improved reversing valve with the valve in the normal position, i. e., in the position it assumes during the cooling period, the section being taken on the line 3—3 of Fig. 4.

Fig. 4 is a section on the line 4—4 of Fig. 3, with the valve in the reverse-cycle or defrosting position.

Fig. 5 is a top plan view of the valve on a smaller scale.

Fig. 6 is a cross section of a refrigerator of the type for which my cooling and defrosting system is particularly adapted, the section being taken on the line 6—6 of Fig. 7.

Fig. 7 is a section on the line 7—7 of Fig. 6.

In the drawings in which like numerals and letters of reference indicate like parts in all the figures, E represents the evaporator, C the condenser and R. V. the reversing valve of a reverse-cycle defrosting refrigerating system.

As shown in Fig. 1, the evaporator coil 1 has one end 1^a connected to a thermostatically operated expansion valve 2 and to a one way check

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valve 3, the valves 2 and 3 being connected, in parallel, to the coil end 1^a and to the beginning or entrant end 4^a of a pipe 4 which passes through a cylinder 6 and has its other end 4^b passed into a receiver 11 to extend below the liquid level therein (see Fig. 2). The other end of the evaporator coil 1 is connected to a pipe 5 which also passes through the cylinder 6 in proximity to the pipe 4 and continues to the port 18 of the reversing valve R. V. The portions of the pipes 4 and 5 which are contained within the cylinder 6 constitute therewith a heat exchanger. In practice the evaporator and heat exchanger are located in a partitioned off space in the refrigerator case R as will later more fully appear.

The condenser C has one end 7^b of its coil 7 connected to a one way check valve 8 and to a restrictor formed by a capillary tube 9. A pipe 10 has its inlet end 10^a connected to the tube 9 and to the valve 8 while its outlet end 10^b passes into the receiver 11, terminating below the liquid level in the receiver. The restrictor and the one way check valve 8 are connected in parallel with one another. The other end of the coil 7 connects with a pipe 7^a that runs from the port 19 of the reversing valve.

12 indicates the compressor, 13 the motor which drives it via a belt and pulley connection 14. The high side of the compressor is connected to a port 21 of the reversing valve by means of a pipe 15. The low side of the compressor is connected with ports 20 and 22 of the reversing valve via pipes 16 and 17.

The construction of the reversing valve is best illustrated in Figs. 3, 4 and 5 by reference to which it will be seen that the valve housing is made in two parts 23 and 24 and ends 27 and 29. The several parts 23, 24, 27 and 29 have stepped engaging portions containing sealing rings 25, 25^a, 28 and are held together in fluid tight engagement by bolts and nuts 30 that pass through apertures in the end plates or heads 27 and 29.

The valve housing contains three chambers 31, 32 and 33 and communicating passages 41^a, 41^b, between the chambers. The port 22 communicates directly with chamber 31, the port 19 communicates directly with passage 41^a and indirectly with chambers 31 and 32. The ends of the passage 41^a are provided with valve seats 34 and 35 respectively.

The port 21 communicates directly with chamber 32 while the port 18 communicates directly with passage 41^b and only indirectly with cham-

bers 32 and 33. Port 20 communicates directly with chamber 33. The ends of the passage 41b are provided with valve seats 36 and 37 respectively.

A valve shaft 38 passes through the chambers and passages of the valve housing and projects above the top end plate or head 29. At its lower end a guide 26 is threaded on the rod as at 38a and pinned thereto as at 26a. The guide 26 operates in a guide-way 27a in the lower head 27.

Mounted on the rod 28 are two one way valves 39, 40 and 45, 46, and one two way valve 42, 43, 44, the two way valve being intermediate the others. The upper and lower valves each are composed of a metal disc 39, 45 respectively and valve seat member 40, 46 respectively.

Securely mounted in an opening in the head 29 is a non-magnetic cylinder 51 in which operates an upper guide 47 carried by the rod 38. Within the cylinder 51 and mounted for free movement along the axis of the cylinder, is an armature 52 of magnetic material through an aperture in which the rod 38 passes. The upper end of the armature is counterbored as at 53 and nuts 50 are secured on the rod within the counterbore. The several valves and the guides on the rod 38 are firmly spaced apart by spacing members 49a, 49b, 49c, 49d, 49e, 49f and washers 48a, 48b, 48c, 48d, 48e as shown.

Embracing the cylinder is the spool 55 on which the energizing coil 56 is wound. The spool 55 is held on the cylinder immovably by the laminated magnetic field plates 54.

When the reversing valve is in its normal position valve 39, 40 seats on seat 34, valve 43, 44 seats on seat 36 while valve 42, 43 and valve 45, 46 are unseated. Therefore ports 19 and 21 are in communication, port 18 is in communication with port 20 (see Fig. 3). When, however, magnet 54, 55, 56 is energized and rod 38 raised, ports 22 and 19 are in communication as are also ports 21 and 18 (see Fig. 4).

In order to energize coil 56 when it is desired to defrost the evaporator I provide an electric circuit which includes power lines 57 from one of which a wire 64 leads to coil 56 and by a branch 62 to a time clock circuit controller 60. A wire 63 connects the time clock with the other line wire 57. The time clock circuit controller includes fixed contacts 66, 67 and a movable contact 61 cooperating with the contacts 66, 67 to close the circuit at predetermined times and hold it closed for a predetermined time interval. Contact 66 is connected to coil 56 by a wire 65 while contact 67 is connected to the other line wire 57 by a wire 68. Thus when contact 61 engages contacts 66, 67 the magnet circuit is closed and core 52 will be sucked up farther into the cylinder 51.

As magnet coil 56 becomes energized core 52 moves up a short distance before engaging the nuts 50 to raise rod 38. As the movement of the core is swift it will impact the nuts and drive the valves 39, 40 and 42, 44 off their seats. This is advantageous should the valves tend to stick. Conversely, when the magnet coil 56 is de-energized the core 52 will drop onto guide 47 and then move down with the guide and valve rod to restore the parts to their normal position.

As before intimated the evaporator is located in a partitioned space in the refrigerator R. By reference to Figs. 6 and 7 it will be seen that the refrigerator case has a front wall 87 with a window 88, a back wall 84, bottom 21, sides 85 with windows 86, a canopy 94 with a mirror 95 and a luminary 96.

79 is a longitudinal partition spaced from the back wall 84, in which space the evaporator E and heat exchanger 4, 5, 6 are located.

The interior of the case is also divided by a horizontal partition 77 into an upper food chamber U and a lower food storage chamber L. The shelf 77 extends forwardly from the partition 79 but terminates short of the front wall of the case (see Fig. 6) and a down air passage is thus provided between the upper and lower chambers. 93 is a down air duct with a foraminous wall to assist in the downward passage of air should the openings in the food shelf 78 become covered. The lower chamber L is provided with a food shelf 92 and a door opening 89 and door 90.

The specific construction of the refrigerator case is not per se a part of the present invention. Means are provided for effecting the circulation of air by providing beneath the evaporator two horizontal partitions 80 and 81 to provide two longitudinal ducts from one side of the case to the other, the upper one 80 having finned openings beneath the evaporator (see Fig. 7). In this manner a high air pressure duct 82 and a low pressure or return duct 83 are provided. At one end of these ducts is located a suction blower 58 and its motor 59 the suction blower being connected to ducts 82 and 83 as shown in Fig. 7. The partition 79 has air outlets 79a to the upper chamber U and air inlets 79b from the lower chamber to the duct 83.

The circuit for motor 59 includes a wire 69 to wire 64 from one line wire 57, a wire 70 to the armature 71 of a relay, a contact 72 and wire 73, 68 to the other line wire 57. Normally armature 71 engages fixed contact 72. The coil 74 of the relay connects by wire 75 to wire 64 and by wire 76 to wire 65. Thus when contacts 61, 66, 67 are closed coil 74 will be energized and armature 71 lifted to open the circuit to the motor 59 and stop the blower. Thus no forced air circulation takes place via the food chambers U and L while the defrosting cycle is on.

From the foregoing description, taken in connection with the accompanying drawings, it is thought that the construction, operation and advantages of the invention will readily appear to those skilled in the art.

What I claim is:

1. A reversing valve for reverse-cycle refrigerating systems having a receiver, a compressor, a condenser, and an evaporator, said valve including: a casing having four chambers, namely, a top chamber, a bottom chamber and two intermediate chambers, there being a passage between the top chamber and the adjacent intermediate chamber, a passage between the bottom chamber and the intermediate chamber adjacent the same, said intermediate chambers being in communication with one another, a valve seat at each end of said first mentioned passage, a valve seat at the juncture of the two intermediate chambers and a valve seat at the bottom end of the second mentioned passage, a valve stem in said casing with a single acting valve in the upper chamber, a double acting valve in the intermediate chamber that is adjacent the top chamber and a single acting valve in the bottom chamber, a duct connecting the top and bottom chambers together, a duct for connecting the upper intermediate chamber with the compressor, a duct for connecting the first mentioned passage with the condenser, a duct for connecting the lower end

chamber with the low side of the compressor, a duct for connecting the lower intermediate chamber with the evaporator, a core having limited axial movement on said stem, and a solenoid for operating the core to raise the stem and valves from one position to the other.

2. In a refrigerating system, a defrosting valve which includes a casing having a top chamber, a bottom chamber and two directly communicating intermediate chambers with a valve seat between the same, a passage with a valve seat at each end for connecting the top chamber with the top intermediate chamber, a passage between the bottom intermediate chamber and the bottom chamber with a valve seat at the lower end of the last named passage, a valve stem in said casing carrying a one-way acting valve in the top chamber, a two-way acting valve in the top intermediate chamber and a one-way acting valve in the bottom chamber, a pipe directly connecting the top and bottom chambers, and a weighted core on said valve stem, and a solenoid cooperative with said core to shift the valve stem and its valves in one direction, the same being shifted in the opposite direction by gravity, said casing having a port from the first mentioned passage to the exterior of the casing, a port from the top intermediate chamber to the exterior of the casing, and a port from the lower intermediate chamber to the exterior of the casing.

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